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SOVIET METHOD USES GRAPHITE ELECTRODE FOR ELECTRICAL HARDENING OF TOOLS

DESCRIBES HARDENING PROCESS -- Moscow, Znaniye-sila, Apr 51

During the past few years, Soviet engineers and students have developed a new, very simple and effective method of tool hardening. This is known as the electrical-hardening method.

The surface of the tool is subjected to successive electrical discharges. With the use of a simple, so-called condenser circuit, conditions are created under which the electric current condenses on minute particles during infinitesimal time intervals. As a result, these particles become heated instantly and then cooled instantly.

The length of the electric impulses is only 1/10,000th or even 1/100,000 of a second. However, the temperature of the metal at the point of discharge application increases to several thousand degrees. Under these instantaneous heat impacts, the steel tool becomes intensely hard and its hardness increases rapidly.

Another process takes place together with the hardening. The steel, in its melted state, combines with the nitrogen in the air. This adds to its hardness while it cools. If a piece of graphite or hard alloy composed of titanium and tungsten serves as the electrode through which the electrical impulse passes to the surface of the metal, the result of the heat impacts is even greater. Particles of the electrode merge with the hardened layer being formed on the surface of the tool, increasing its hardness and durability even more.

Electrical hardening considerably lengthens tool life. The use of this method in Soviet industry is saving the state hundreds of millions of rubles per year.

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DIRECT-CURRENT HARDENING DOUBLES DURABILITY -- Moscow, Sel'khozmashina, Mar 51

Electric-spark hardening of cutting-tool edges is finding wide application in agricultural-machine building. Several hundred electric-spark-hardening units are being used at plants. Most of these units are of the KEI-1 type.

During 1949-1950, the laboratory of TsITM MSKhM (Central Institute for the Organization of Labor and Mechanization of Production, Ministry of Agricultural-Machine Building), in cooperation with the Lubertsy and Tula plants, conducted research on the development of these processes. The following results were obtained on increasing the durability of cutting tools hardened by the electric-spark method:

1. Lathe, turret lathe, and planing tools, as well as milling cutters made from RF1 steel, which are used for roughing cast iron or machine steel. Durability increased 1.5 to 2.5 times.

2. Drill and counterbore bits, made from RF1 steel, used for machining cast iron and machine steel (hardening material used, graphite EG-2). Durability increased 1.5 to 2 times.

3. Module hobs made from EI262 steel, for machining modified pig iron; hardening material, graphite EG-2; also the same hobs for machining 18KhGT steel. Durability increased 2.5 to 3 times.

4. Carpentry tools made from U8A steel; hardening material, graphite EG-2. Durability increased up to eight times.

5. Hand chisels and chisels for pneumatic tools made from U7 and U8A steel; hardening material, T15K6 hard alloy. Durability increased 2 to 3 times.

Hardening was done on an experimental unit under conditions shown in the table below:

Condition (rezhim)	Voltage U (v)	Capacitance C (mfd)	Short-circuit current I_k (in amp)
Severe	100-150	150-200	2.5-3.6
Average	80-100	50-100	1.5-2.5
Light	80-100	5-10	0.5-1

At agricultural-machine-building plants, the KEI-1 unit has been operating under conditions shown in the following table:

Condition	U (v)	C (mfd)	I_k (amp)
Severe	210	120	1.5
Semisevere	210	86	1
Average	210	40	0.75
Light	210	6	0.25

In 1950, the laboratory was assigned the task of ascertaining the influence of hardening on the durability of automatic forming tools made from RF1 steel for use in finishing operations, with feeds of 0.019 to 0.057 millimeters per revolution.

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Two units were designed and manufactured for this purpose; the TsITM-UPT-1 unit for work on alternating current and the TsITM-UPT-2, for work on direct current. These units are more powerful than the KEI and can operate under intensified conditions.

The design of the units was based on the principle that for operating on a direct current the optimum capacitance which would give the best length of discharge would be 200 microfarads, and the over-all resistance of the discharge circuit should not exceed 0.02 ohms.

According to the data of research organizations, and considering the compactness of the alternating-current unit, a capacitance of 60 microfarads has been accepted for it.

Technical Specifications

	UPT-1	UPT-2
Line voltage (v)	127 220	127-220
Output voltage (v)	0 70	0-150
Output current (amp)	0.2	0-2
Capacitance (mfd)	60	20-200 (in 20-mfd steps)
Ballast resistance of the discharge circuit (ohm)	28	48
AC voltage applied to the vibrabor (v)	60	60
Dimensions of unit (mm)	330 x 205 x 185	370 x 325 x 265
Weight (kg)	7	15
Resistance of half of discharge circuit (dc ohm)	Not more than 0.01	0.01
Power consumption(w)	120	120

Basic parts and instrum nts required for th manufacture of the UPT-1 and UPT-2 units are standard industrial items. A frame, chassis, vibrator, resistor, and fastening parts are manufactured for assembling the units.

The units' basic element is the LATR-2 laboratory autotransformer produced by machine- and instrument-building plants. Taking accident prevention into consideration, the LATR-2 in its completed form cannot be used in these units because of the high voltage in output in relation to the ground. Therefore, its circuit was changed to a transformer where the secondary coil is only inductively coupled with the primary. The change was made by exposing the coil one-quarter of its length, covering it with insulation (two layers of cambric cloth), and then winding a new primary coil made of 810 turns of 0.41 millimeter PEL wire (for the UPT-2).

The ballast resistor for the discharge circuit is manufactured from a 0.4 millimeter diamter nichrome wire on a ceramic or porcelain base, with an over-all resistance of 28 ohms for the UPT-1 unit and 48 ohms for the UPT-2 unit.

Condensers having a capacitance of 4 microfarads with an operating voltage of 160 volts are used on both units.

The rectifier is a full-wave type using two VS-51 rectifier stacks in each arm. Any small 120-220 volt neon tube can be used; with a 120-volt tube, the resistance is 0.1 meghoms.

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The UPT-2 unit is assembled on a duraloy (dyuralevoy) chassis fitted into a one-piece silumin box. Measuring instruments, a lever for controlling the transformer, switches, terminals for the vibrator, and terminals for the electrode-tool and work piece are mounted on the front panel.

The vibrator has alternating current supply (with additional resistance of 2,000 ohms) as shown in the appended sketches.

The vibrator coil has 11,000 turns of 0.16-0.18 wire; the spring is adjusted during assembly.

The UPT-1 and UPT-2 units are equipped with a suitable, light pencil-type vibrator (KhTZ design). During a 3-month testing period at the Tula Plant, the units operated without breakdown. Since the units are made of standardized parts, their assembly is simple and they can be manufactured at any workshop. The range of the UPT-2 operating conditions makes possible electric-spark hardening of all types of tools used in agricultural-machine building, with graphite for tools for finishing operations or with hard alloy tools for roughing operations.

It was established at the Tula Combine Plant that it is best to harden disk automatic-forming and cutting-off cutters along the front edge. The optimum operating conditions for hardening with electrode-graphite EG-2 for direct current is U,85 volts; I_k,1 ampere; C,20 microfarads; and for alternating current, U,40 volts; I_k,1.8 amperes; C,60 microfarads.

In machining steel 35 on a five-spindle automatic with hardened cutters (the criterion of dulling being the formation of a 0.5-0.7-millimeter burr on the front edge) at a peripheral speed of 30 meters per minute, with a feed of 0.028 /millimeters?/ and the use of "sulfofrezol" coolant, the following results were obtained:

A cutter which has not been hardened can produce 1,240 parts. When it is hardened by direct current, its durability more than doubles; in other words, a cutter hardened by direct current can machine 2,506 parts. When hardened by alternating current, its durability increases 1.6 times; in other words, it can machine 1,985 parts. Consequently, the durability of a cutting tool hardened by alternating current is 40 percent lower than one hardened by direct current.

/Appended sketches follow./

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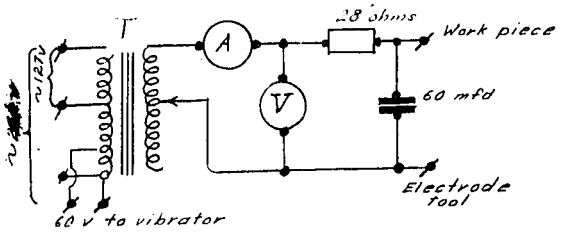
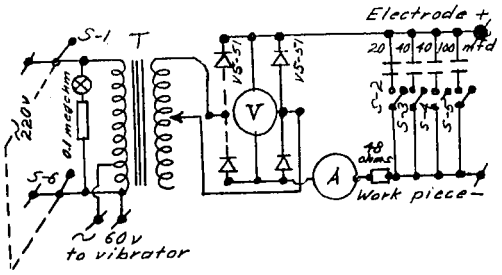
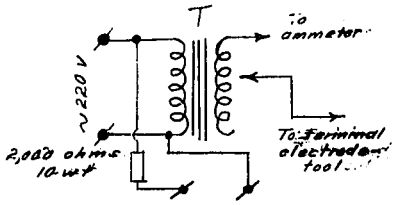


Electrical Circuit for TsITM-UPT-1 Unit



Electrical Circuit for UPT-2 Unit



Circuit for Including Vibrator With Additional Resistance

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